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	Engineering and Design DESIGN ANALYSIS, DRAWINGS AND SPECIFICATIONS	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

ER 1110-345-700

CEMP-EA

Regulation
No. 1110-345-700

30 May 1997

Engineering and Design
DESIGN ANALYSIS, DRAWINGS AND SPECIFICATIONS

1. Purpose. This regulation provides U.S. Army Corps of Engineers (USACE)-wide consistent criteria and requirements for developing design and engineering documents, such as design analysis, drawings and specifications, necessary for the construction of military construction (MILCON) and/or Hazardous, Toxic and Radioactive Waste (HTRW) projects including EPA Superfund.

2. Applicability. This regulation is applicable to all USACE Commands having MILCON, and/or HTRW design responsibility.

3. Organization. This regulation is divided into appendices that contain criteria and requirements related to the subject of the respective appendix. Each appendix is structured to provide criteria and requirements applicable to military construction and/or HTRW projects, except as may be otherwise provided for in other Engineer Regulations (ER), design directives or special instructions.

a. Appendix A, References. This appendix provides a listing of references used in this regulation.

b. Appendix B, Design Analysis. This appendix prescribes requirements and procedures for the preparation of design analysis (basis for design) of military and/or HTRW construction projects.

c. Appendix C, Drawings. This appendix prescribes requirements, procedures and

drafting standards for the preparation and approval of drawings for military and/or HTRW construction projects. It includes drawings, other than shop drawings, prepared at all stages of design and construction.

d. Appendix D, Specifications. This appendix prescribes policy and requirements for the preparation of contract specifications for military and/or HTRW construction projects. It includes USACE guide specifications and project specifications, and procedures for the construction industry to follow when introducing new materials, equipment and methods into HQUSACE guide specifications.

4. Distribution. This regulation is approved for public release, distribution is unlimited.

5. General Design Policy. The Commanding General (CG) of the USACE is responsible for design, engineering and construction mission of the Army worldwide. The CG is also responsible for the execution of assigned design and construction programs or projects for other Department of Defense (DoD) agencies, other Federal agencies, and foreign governments. Highest standards of professional skills, experience and management practice are required to support this responsibility. Required facilities and component parts thereof will be carefully sited, designed, and executed so the resulting construction is of the highest quality that could possibly be provided within the cost and time authorized, without sacrificing aesthetics, user requirements, life-cycle

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economy, energy conservation, environmental protection, or life safety. Additional design policy information is contained in ER 1110-345-100, Design Policy for Military Construction.

6. Proponency. Proponent for this regulation

is the Architectural and Planning Branch, Directorate of Military Programs (CEMP-EA). Comments regarding improvements and/or clarifications should be submitted to the proponent office at HQUSACE, 20 Massachusetts Ave., NW, Washington, DC 20314-1000.

FOR THE COMMANDER:

3 Appendices:

APP A - References

APP B - Design Analysis

APP C - Drawings



OTIS WILLIAMS

Colonel, Corps of Engineers

Chief of Staff

APPENDIX A

REFERENCES

(References used in this regulation)

1. **Public Law.** Public Law 94-168, Metric Conversion Act of 1975 as amended by the Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418).
2. **Executive Order.** Executive Order 12770, 25 July 1991, Metric Usage in Federal Government Programs.
3. **Federal Acquisition Regulation.**
 - a. FAR, Part 10, Specifications, Standards, and Other Purchase Descriptions. Specifically cited are subparts 10.002, Policy and 10.004, Selecting Specifications or Descriptions for Use.
 - b. Subpart 6.3, Other Than Full and Open Competition.
4. **Engineer FAR Supplement.** EFARS 14.201-1(a)1, USACE Construction Contract Format.
5. **Department of the Army.**
 - a. AR 190-13, The Army Physical Security Program.
 - b. AR 190-50, Physical Security for Controlled Medical Substances and Other Medically Sensitive Items.
 - c. AR 200-1, Environmental Protection.
 - d. AR 380-5, Department of the Army Information Security Program Regulation.
 - e. AR 385-60, Coordination With Department of Defense Explosives Safety Board.
 - f. AR 415-1-10, Contractor Submittal Procedures.
 - g. AR 415-11, Air Force Contract Construction.
 - h. AR 415-15, Army Military Construction Program Development and Execution.
 - i. AR 415-17, Cost Estimating for Military Programming.
 - j. AR 415-28, Real Property Category Codes.
 - k. TM 5-802-1, Economic Studies for Military Construction.
6. **U.S. Army Corps of Engineers.**
 - a. ER 385-1-92, Safety and Occupational Health Document Requirements for HTRW and Ordnance Explosives Waste Activities.
 - b. ER 415-1-10, Contractor Submittal Procedures.
 - c. ER 415-1-11, Biddability, Constructibility and Operability.
 - d. ER 415-345-38, Transfer and Warranties.
 - e. ER 715-1-10, Architect-Engineer Responsibility Management.
 - f. ER 1110-1-12, Quality Management.
 - g. ER 1110-1-263, Chemical Data Quality Management for Remedial Activities.

h. ER 1110-1-1300, Cost Engineering Policy and General Requirements.

i. ER 1110-1-8152, Professional Registration.

j. ER 1110-3-113, Department of the Army Facilities Standardization Program.

k. ER 1110-3-1300, Military Programs Cost Engineering.

l. ER 1110-3-1301, Cost Engineering Policy and General Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Remedial Action Cost Estimates.

m. ER 1110-345-100, Design Policy for Military Construction.

n. ER 1110-345-122, Interior Design.

o. ER 1180-1-6, Construction Quality Management.

p. ENG Form 3078, Recommended Changes to Engineering Documents.

q. EP 310-1-6, Graphics Standard Manual.

r. EP 1110-1-21, Air Pathways Analysis for Design of HTRW Remedial Action Projects.

s. EP 1110-345-2, Index of Drawings.

t. EM 200-1-2, Technical Project Planning Guidance for HTRW Data Quality Design.

u. Architectural and Engineering Instructions (AEI).

(1) Design Criteria, issued by HQUSACE (CEMP-E). Copies are available from the Huntsville Engineering Support Center (CEHNC-ED-ES-1), P.O. Box 1600, Huntsville, AL 35807-4301.

(2) Medical Design Standards, issued by HQUSACE (CEMP-EM).

(3) Simplified Design Methods, issued by HQUSACE (CEMP-EA).

v. USACE Supplement 1 to AR 190-13, The Army Physical Security Program.

w. USACE Supplement 1 to AR 380-5, Department of the Army Information Security Program Regulation.

7. National Building Codes.

a. International Conference of Building Officials, Uniform Building Code (UBC), 5360 South Workman Mill Road, Whittier, CA 90601.

b. National Fire Protection Association (NFPA) 101, Life Safety Code, Batterymarch Park, Quincy, MA 02269.

8. National Standards Organizations.

a. American National Standards Institute. 28 October 1992. "American National Standard for Metric Practice," ANSI/IEEE 268-1992, IEEE Standards Coordinating Committee 14 on Quantities, Units, and Letter Symbols, New York.

b. American Society for Testing and Materials. 1991. "Standard Practice for the Use of Metric (SI) Units in Building Design and Construction," ASTM E 621-84 (Reapproved 1991), Committee E-6 on Performance of Building Construction, Philadelphia, PA.

c. American Society for Testing and Materials. 1992. "Standard Practice for the Use of the International System of Units (SI) (the Modernized Metric System)," ASTM E 380-92, Committee E-43 on Metric Practice, Philadelphia, PA.

d. National Institute of Building Sciences.1991. "Metric Guide for Federal Construction," Interagency Council on Metric Policy, Washington, DC.

e. MasterFormat™, Construction Specifications Institute (CSI), 601 Madison Street, Alexandria, VA 22314-1791.

APPENDIX B

DESIGN ANALYSIS

1. General. This appendix prescribes the requirements and procedures for the preparation of design analysis (basis for design) for military and/or HTRW construction projects.

2. Design Analysis Requirement.

a. A design analysis will accompany project drawings and specifications required for all new construction and/or HTRW remedial action projects, and projects involving major alteration or expansion of existing facilities, unless specifically exempted.

b. A design analysis shall be developed by the architect-engineer (design agency in-house or contracted design professional) of record for the military and/or HTRW construction project being designed.

c. The design analysis is developed in coordination with installation or customers, and summarized in a format appropriate for:

- (1) Review, approval and record purposes.
- (2) Revision of designs during construction, as required.
- (3) Use in adapting designs to other sites.
- (4) Operations and maintenance (O&M) enhancement and cost reduction.
- (5) Post-occupancy evaluation.

d. Design analysis shall be prepared in metric. Where computer programs or technical references are used, the metric version of the program or reference is preferred and should be

used. Where metric versions are not readily available or practical, that portion of the design analysis based on non-metric program or reference may use inch-pound (IP) units. In these cases, the final values that are to be placed in the contract documents shall be converted to their metric equivalent in the design analysis prior to use in project drawings or specifications. Unit designations and conversions shall be in accordance with ASTM E 621-84 as modified by the Metric Guide for Federal Construction, unless specifically indicated otherwise.

3. Definition. A design analysis is a document that contains written material covering general parameters, functional and technical requirements, design objectives, design assumptions, and provides design calculations applicable to a project's design.

4. Organization and Content. The design analysis will be organized into three parts; Part 1 - "General Description," Part 2 - "Design Requirements and Provisions," and Part 3 - "O&M Provisions." Characteristics of the three parts of a design analysis are as follows:

a. General Description (Part 1). This part of the design analysis will state the purpose, authorization, applicable criteria and the project description for the project, and provide a summary of the factors influencing the choice of the civil, environmental, architectural, structural, mechanical, electrical, communications, fire protection, physical security systems, and HTRW aspects used in the project along with an indication of how the initial and life cycle costs were considered. Identify all additional utility requirements,

calculate the total requirement, and compare the total existing capabilities. The requirements of the Record of Decision or other decision document will be included for HTRW projects.

b. Design Requirements and Provisions (Part 2). This part of the design analysis will include subparts for each major design discipline and basic project design requirements that should be addressed in the design analysis with justifications to validate the design decisions. Additional facility requirements are provided in Architectural and Engineering Instructions (AEI), Design Criteria, and its appendices, and special medical facility design requirements in AEI, Medical Design Standards.

(1) Civil. This includes soil analysis and survey data, site design, site improvements, planting and landscaping, paving, grading and drainage, water, waste-water and soil treatment, contaminant containment, utilities systems analysis and design, and provisions for airfields, ports and railroads, if required.

(2) Environmental. This includes an impact assessment checklist covering air, water and noise effects from the project and construction; worker health and safety; HTRW remediation cleanup and action levels; transportation and disposal regulation requirements; quality control for chemical sampling/analysis; wetlands determination (tidal and nontidal); special wildlife, plant, and endangered species considerations; ground water, waterway and floodplain protection assessment; pollution prevention control requirements; and design measures to be implemented (i.e., construction site sediment and erosion control requirements by Federal, state and local governments); and hazardous material management, natural and cultural resources, and environmental permits.

(3) Architectural. This includes space allowance, functional layout, interior design, furniture planning, signage, accessibility,

security, energy conservation, space-mass composition, materials used and details with respect to image, safety, maintenance and cost effectiveness.

(4) Structural. This includes foundation, structural, seismic, hardened structure, nuclear radiation and blast protection systems analysis and design.

(5) Mechanical. This includes heating, ventilation and air conditioning systems, refrigeration, plumbing, elevators and cranes, energy conservation, pollution control, noise and vibration control, heating and chilled water distribution, gas distribution, fuel storage and dispensing, and process systems design.

(6) Electrical. This includes power generation, transmission and distribution systems, lighting (interior and exterior), voice and video communications, intrusion detection, utilities monitoring control systems (UMCS), cathodic protection, lightning and static electricity protection systems analysis and design, aviation lighting, and electromagnetic protection.

(7) Fire Protection and Life Safety. This includes building construction, exit requirements, fire extinguishing systems, fire protection water supplies, surge analysis, and alarm and detection systems analysis and design.

(8) Physical Security. This includes fencing, vaults, protective lighting, security systems, locks, arms rooms, controlled substances, entrances, guard facilities, classified material, patrol roads, clear zones, restricted areas, surveillance and penetration resistance.

c. Operation and Maintenance (O&M) Provisions (Part 3). This part of the design analysis will describe the design provisions

made to enhance and to reduce the cost of operating and maintaining the facility when completed.

(1) This part of the design analysis should include the O&M design intentions for the major design disciplines covered in Part 2.

(2) This part of the design analysis will be in a format that can be used separately to supplement the completion records required by Army Regulation (AR) 415-1-10, or to form the basis for assembling a facility user's manual.

d. Special Aspects for HTRW Projects.

The design analysis for HTRW projects will include all applicable regulatory, chemical sampling/analytical, safety and occupational health, geotechnical, cost engineering, and process engineering provisions and criteria required by the HTRW guidance references listed in Appendix A and the HTRW examples listed in Appendix B (Part 2).

5. Preparation.

a. Assembly and Identification.

(1) The design analysis should be assembled, when possible, into a single volume with a complete table of contents. When more than one volume is required, each volume should be labeled, numbered sequentially and assembled under a cover page. The cover page should indicate the volume number and the total number of volumes in the design analysis for the project. Likewise, the cover page should indicate the name and location of the project, the project number and fiscal year, and the identification of the design agency. Applicable local file numbers and references to drawings, including Computer Aided Drafting and Design (CADD) file numbers, and specification numbers will be included as appropriate.

(2) Studies performed as part of the design

process, such as life cycle cost analysis, energy use budget and design energy use calculations and simulations, solar feasibility analysis, treatability studies, and hydro geological modeling will be stand alone reports and included in the design analysis as appendices (referenced in the design analysis as appropriate).

b. Size and Layout.

(1) The table of contents, cover page layout and page layouts, as appropriate, will be guided by the standards prescribed and delineated in this ER. Supplemental guidance may be found in Engineer Pamphlet (EP) 310-1-6.

(2) The design analysis will be clearly and legibly expressed.

(3) All materials will be prepared in relation to a vertically oriented A4 metric, 210 mm x 297 mm (8.3 inches x 11.7 inches) standard page size (8-1/2 x 11-inch when metric paper stock is not available). Larger material may be folded to the standard page size, i.e., when reduction is not feasible, the A3 metric sheet, 297 mm x 420 mm (11.7 inches x 16.5 inches), easily accommodates folding in to the A4 metric sheet as a half-size of a standard A1 metric construction drawing.

(4) When drawings, published data or automated data processing printouts are used, these materials will be trimmed, reduced or folded to conform to the standard page size.

c. Classified Material. Every effort will be made to prepare the design analysis to be an unclassified document with proper references to sources of classified material.

d. Design Calculations. Design calculations will be computed and checked for accuracy and initialed or signed by qualified design professionals, applicable by discipline,

other than the project's designer. The names or initials of these individuals will be indicated on the page, or an insert, carrying the calculation.

(1) All design assumptions, loads and conditions, as applicable, will be clearly indicated and legible with tabulations indicated on the page, or an insert, carrying the calculation, and will be clear and legible with the tabulation. The sources of loading conditions, design assumptions, formulas and references will be identified. Assumptions and conclusions will be explained and cross-referenced.

(2) When a commercial computer program (software) is used:

(a) The program will be named and described to include a flow chart, or other documentation, showing how the program attains the solution. This description must be sufficient to verify the validity of methods, assumptions, theories and formulas, but should not require source code documentation or otherwise compromise any proprietary programs.

(b) The input shall be reviewed for accuracy and initialed or signed by a registered architect or engineer, or design professional as applicable to the input being checked. The output shall be

reviewed to ensure the reasonableness and applicability of the result and initialed or signed by the design professional that reviewed the input.

e. **Use of Existing Design Analysis.** If a standard design or other design is being site adapted, the design analysis for the new project will include appropriate material from the existing design analysis modified to incorporate site adaptations and other essential requirements.

6. Exceptions to Appendix B Requirements.

a. **Medical Facility Projects.**

b. **Family Housing Projects.**

c. **Army Reserve Projects.**

d. **Non-appropriated Funds (NAF) Projects.**

e. **Design-Build Projects.**

f. **Simplified Design Method (SDM) Projects.**

g. **Defense Environmental Restoration Program, Superfund, and BRAC time critical removal actions (including Ordnance and Explosives projects).**

- PART 1 -

GENERAL DESCRIPTION

1. Design Analysis. The design analysis -Part 1- will comprise five (5) sections with subsections as follows:

a. Purpose. A purpose section will be provided with a description of the project's functional purpose and other supporting dialogue from project information prepared by the installation and the organization for which the project is to be designed.

b. Authorization.

(1) Directives. A synopsis of applicable design directives for the project will be included in this part of the design analysis. For HTRW projects, include a discussion of the appropriate Federal and/or state regulations governing the project (RCRA, CERCLA, Clean Water Act, etc.).

(2) Scope of Work. A synopsis of the project authorized under the DD Form 1391 program, A106, FUDS work plan or ROD (record of decision) will be included in this part of the design analysis, to include the authorized project scope of work and programmed amount.

c. Criteria. References will be made to applicable Technical Manuals (TM), ER, AEI, Engineering Instructions (EI), other prescribed criteria, specific studies and minutes of meetings held to define the scope of the project, cost limitations and the character of the design.

d. Project Description.

(1) Project Site. A synopsis will be provided that indicates the general site conditions, project siting requirements, existing utilities available to the site, topography,

wetlands designated areas, unusual environmental characteristics to be impacted by the project, and conformance with the installation master plan.

(2) Functional Objective. The basic functional objective or objectives of the proposed project and the estimated functional life will be described.

(3) Personnel and Equipment. The number of civilian and military personnel and visitors, and the types of service and/or organizational equipment to be accommodated in the project will be described.

(4) Constructibility. The basic construction materials and systems selected, and the estimated structural life of the project will be described.

e. Economic Summary. Economic factors affecting the project will be described, especially those factors influencing the choice of basic materials, and the civil, architectural, structural, mechanical, electrical and fire protection systems selected to include:

(1) Results of economic studies which consider not only the initial construction cost but also costs incurred over the estimated functional life of the project. Applicable requirements in ER 1110-1-1300, ER 1110-3-1300, ER1110-3-1301, and TM 5-802-1 must be adhered to in preparation of cost estimates.

(2) Results of value engineering studies performed on the project design.

(3) Design analysis prepared so that they may be edited using computer systems and

software standards by the design agency.

2. Review and Approval. Review and approval of design analysis will coincide with the review and approval of the project drawings and specifications in accordance with Appendices C and D of this ER including:

a. Project Engineering with Parametric Estimating Design Stage (Code 3). The general summary statement will be in accordance with Architectural and Engineering Instructions (AEI), Code 3 Design.

b. Concept Design Stage (Code 2). The design analysis will cover the progress of all of the design disciplines (refer to Part 2).

c. Final Design Stage (Code 6). All parts of the design analysis, including the O&M provisions (refer to Part 3), will be complete within themselves, without requiring reference back to earlier design analysis. Review and

approval of final design drawings and specifications will be done concurrently with the review and approval of the final design analysis.

d. Drawing Modifications. When modifications of project drawings are authorized, as set forth in Appendix C of this regulation, the design analysis for the changed conditions will be added to the design analysis and the revision date or dates noted.

3. Disposition and Reference Copy. The final design analysis with revisions and the as-built drawings will be transferred to the using service after acceptance of the project. A reference copy of the design analysis will be retained separately by the design agency for possible use in adapting the project design to another site or in evaluating lessons learned. Reference copies of the design analysis will be retained by the design agency for at least two years after the beneficial occupancy date (BOD) of the project.

- PART 2 -

DESIGN REQUIREMENTS AND PROVISIONS

1. Civil.

a. General Parameters. Examples of general civil parameters that need to be addressed are:

(1) Site boundaries controlled and uncontrolled access, limits (boundries) of contaminated soil and/or ground water, and total area.

(2) Topography and soil drainage characteristics.

(3) Results of geotechnical explorations, laboratory and field testing; soil and rock elevations, classifications and characteristics; and groundwater elevations.

(4) Special considerations, such as dynamic loading, expansive soils, permafrost or dewatering, and precautions during construction.

(5) Prevailing winds, sun angles, design temperatures and precipitation.

(6) Existing structures, parking, vegetation, open spaces and outdoor recreation areas. Functional relationships relative to adjacent facilities, exclusion zone, or decontamination facilities.

(7) Disposition of major utilities, transportation arteries and access roads to include other planned projects by title, fiscal year and line item number.

(8) Proposed facilities, buildings, support buildings, parking, access roads, service areas,

utilities and helipads.

(9) Former use, demolition responsibilities and location (with justification) of borrow pits, disposal areas and contractor plant areas, including HTRW wastes.

(10) Local construction practices, availability of materials, labor and skills, and use of industrialized components.

(11) Installation compatibility, and future use considerations.

(12) Permit requirements, as applicable.

(13) Contaminant characteristics and final treatment parameters

(14) Treatment facilities startup.

(15) Any other civil parameters necessary for special project designs.

b. Functional and Technical Requirements. Examples of civil related functional and technical requirements that need to be addressed are:

(1) Orientation of elements of the project to conserve energy and to reduce site preparation.

(2) Exterior functional areas, relationships and space allowances for operational, storage and support activities.

(3) Accessibility for handicapped (physically impaired or disabled) persons.

(4) Grading, storm drainage and irrigation.

(5) Landscape design and planting.

(6) Exterior signage and outdoor furnishings.

(7) Area and sign lighting.

(8) Sidewalks, retaining walls, fencing, traffic controls and barriers.

(9) Parking, access roads, including haul roads for transport of hazardous material for disposal, and access for service and emergency vehicles, to include paving design, and railroads and airfields.

(10) Service areas for pick-up and deliveries, bulk waste storage or disposal and exterior utility elements (transformer, chillers, etc.).

(11) Building set-backs, spacing of structures and maximum walking distances.

(12) Exterior utility support systems, to include fire protection water and storm drainage.

(13) Heliport and airfield clear approach and landing.

(14) Heliport and airfield illumination, and marking.

(15) Treatment equipment layout and operational flexibility.

(16) Operation, maintenance, and staffing levels at treatment facilities.

(17) Material selection for monitoring and extraction well construction and associated discharge piping.

c. Design Objectives and Provisions.

Examples of civil related design objectives and provisions that need to be addressed are:

(1) Vehicular and pedestrian circulation patterns.

(2) Landscape preservation, composition and perception.

(3) Functional relationships of buildings and support facilities, to include off-site facilities and areas impacting on the site design.

(4) Barrier-free design for handicapped (physically impaired) persons.

(5) Utility support and isolation.

(6) Economy of construction and the operations and maintenance of the project relative to life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) Future expansion, if applicable.

(8) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(9) Instrumentation requirements at treatment facilities.

(10) Evaluation of construction materials.

d. Calculations. The calculations for civil design elements, such as those listed below, will utilize metric units. If the project is permitted to use inch-pound (IP) units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Soil bearing capacities, settlement analysis, slope stability, erosion control, lateral earth pressures and frost design.

(2) Road, paving, grading and storm drainage design.

(3) Landscape design irrigation systems, if applicable.

(4) Parking allowances for civilian, military and visiting personnel, handicapped (physically impaired) persons and organizational equipment.

(5) Verification of the adequacy of existing and planned utility systems required for complete project support.

(6) Sizing of domestic water and fire protection systems.

(7) Sizing of waste-water collection systems, to include maximum flow rated in liters per second for waste-water and sewage, and the total flow per day.

(8) Railroad design, if applicable.

(9) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(10) Estimated cost of construction.

(11) Treatment equipment sizing and selection

(12) Treatment facility mass balances for all major process streams.

(13) Aquifer parameter determination, fluid (ground water or air) production rates and/or velocities, extraction/injection well spacings, filter pack design, and documentation of modeling used in system design.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Siting in accordance with the Major

Army Command (MACOM) approved installation master plan.

(2) Utility service capacities and central plant support.

(3) Water supply and sanitary discharge, including on-site treatment plant discharge.

(4) Demolition and debris disposal.

(5) Fire fighting support.

(6) Bulk trash and non-hazardous waste disposal procedures.

(7) Signage makeup and maintenance.

(8) Construction and other permits, as applicable.

(9) Safety siting approval for explosives-handling facilities as required in AR 385-60 for coordination with the DoD Explosives Safety Board, if applicable.

(10) Waste Manifesting.

2. Environmental.

a. General Parameters. Examples of general environmental parameters that need to be addressed are:

(1) Completed Environmental Impact Assessment (EIA) checklist covering the air, water and noise effects of the project on the site and adjacent sites. This is often already completed by the installation, but validation by the design agency or contract Architect-Engineer (A-E) is required.

(2) Identification of wildlife and plants that are adversely impacted by the placement and operation of the project on the site. Rare or endangered species must be identified and

specifically reported.

(3) Maps indicating wetland designations on the site or adjacent sites affected by the project or the construction of the project.

(4) Archeological preservation, to include cemetery identification.

(5) Ground water and waterway locations.

(6) Pollution prevention and control measures during construction and the operation of the project.

(7) A comprehensive environmental permit/regulation analysis which addresses air, water, solid and hazardous waste as appropriate. Examples include Clean Water Act operating permits, storm water and point source discharge permits, hazardous waste storage and treatment permits, emergency planning and community right-to-know (EPCRA) and state and local environmental permits and related issues.

(8) Health and Safety Design Analysis (HSDA) in accordance with ER 385-1-92.

(9) Air Pathways Analysis (APA) in accordance with EP 1110-1-21.

(10) Data Quality Objectives (DQOs) for cleanup verification/process performance chemical sampling and analysis developed in accordance with EM 200-1-2.

(11) Media-specific cleanup levels on ARARs or acceptable residual risk calculations.

(12) Contaminant-specific ambient air action levels for health protection of offsite human receptors.

(13) Substantive elements of the Quality Assurance/Quality Control (QA/QC) program to

be utilized in generation of any chemical analytical data. (Refer to ER 1110-1-263 for QA/QC program elements).

b. Functional and Technical Requirements.

Examples of environmental related functional and technical requirements that need to be addressed are:

(1) Project orientation relative to environmentally sensitive areas on or adjacent to the site.

(2) Site modification and storm water runoff affects on ground water, waterways and wetlands.

(3) Discharges relative to the affects on the immediate environs.

(4) Sound and vibration control.

c. Design Objectives and Provisions.

Examples of environmental related design objectives and provisions that need to be addressed are:

(1) Functional relationship of the project to the environment.

(2) Roadway and parking areas storm water runoff effects.

(3) Utilities placement relative to environmentally sensitive areas.

(4) Economic aspects for environmental protection measures and methods.

(5) Future expansion possibilities affects on the environs.

(6) Economic aspects of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) For HTRW remediation designs, an evaluation of remediation goals (i.e., projected endpoints) as they relate to proposed remediation goals and the remedial design.

d. Calculations. The calculations for environmental design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Erosion control protection measures and methods.

(2) Ratio of the paved areas and the building area relative to the total site area.

(3) Storm water runoff.

(4) Air, water, HTRW and sanitary discharge, and impacts on receiving media.

(5) Pollution abatement systems and their scopes.

(6) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1, ER 1110-1-1300, ER 1110-3-1300, and/or ER 1110-3-1301.

(7) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Validation (check) of the approved siting relative to the designated areas of the installation for preservation and pollution protection requirements.

(2) Federal, state, and local governmental approvals as required for wetlands and other environmental protection laws.

(3) Storm water runoff.

(4) Air, water, HTRW, and sanitary discharges.

(5) Sediment and erosion control during construction.

3. Architectural.

a. General Parameters. Examples of general architectural parameters that need to be addressed are:

(1) Purpose, functions and capacities of the project.

(2) Desired image or visual appearance to include the design of the exterior and interiors of the building, refer to Engineer Regulation (ER) 1110-345-122 regarding interior design.

(3) Number of civilian, military and visiting personnel to use the project.

(4) Types of activities, equipment and vehicles involved.

(5) Anticipated life of the functions to be accommodated.

(6) Type and method of construction; permanent, temporary or relocatable.

b. Functional and Technical Requirements. Examples of architectural related functional and technical requirements that need to be addressed are:

(1) Functional areas, occupant capacities and space allowances.

(2) Exterior and interior finish materials, to include textures, colors and damage resistant.

(3) Equipment, furniture and furnishings, to

include all items required regardless of funding; refer to ER 1110-345-122 regarding funding distinctions.

(4) Directional, informational and motivational signage.

(5) Accessibility for handicapped (physically impaired) persons, barrier free design, and provisions for blind vending areas operated by State agencies.

(6) Energy conservation, to include solar energy applications and energy use budget goals.

(7) Occupational safety and health.

(8) Sound and vibration control.

(9) Interior parking and service areas.

c. Design Objectives and Provisions.

Examples of architectural related design objectives and provisions that need to be addressed are:

(1) Adaptation of the building to the size, shape and orientation of the site, to include benefits from natural warming and cooling effects afforded by the site.

(2) Organization of functional spaces to establish workable adjacency relationships.

(3) Building layout to establish convenient circulation flows for people, services, materials and equipment, to include evacuation during emergencies.

(4) Consolidation of spaces into sound-compatible zones and protective construction zones, to include fire, storm and fallout.

(5) Space layout compatible with modular

(structural and environmental) support systems.

(6) Types of construction materials, architectural systems and finishes, to include the basis for their selection.

(7) Composition of masses and spaces, and architectural details to reflect the desired image, and the scale and nature of the activities involved.

(8) Perception of the building details and volumes. Specific provisions made, to include an identifiable sequence of viewing positions for experiencing the architectural and interior design.

(9) Building expandability and changeability.

(10) Energy conservation.

(11) Acoustical design.

(12) Enhancement of materials and systems operations and maintenance.

(13) Economy construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for architectural design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Net room areas, occupant capacity and gross building areas. Categorize these areas and capacities under administrative, operational, storage and support requirements.

(2) Ratio of exterior window and room area, where applicable.

(3) Thermal conductance values for each

building section, which should be selected in coordination with the mechanical engineer design professional to satisfy life cycle cost and energy conservation requirements.

(4) Estimated annual unit energy consumption, which is, in coordination with the mechanical engineer, to determine the design energy use and compliance with the energy use budget.

(5) Acoustics, if applicable.

(6) Roof drainage.

(7) Estimated cost of construction.

(8) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Blind vending area operations.

(2) Make-up of signage.

(3) Government-furnished furniture and equipment.

(4) Occupational safety and health, as required.

(5) Operations and maintenance support.

4. Structural.

a. General Parameters. Examples of general structural parameters that need to be addressed are:

(1) Foundation characteristics based on geotechnical survey and subsurface

investigation.

(2) Conditions related to possible seismic events, wind, storms and blast.

(3) Size of areas and volumes to be inclosed, and floor loads.

(4) Permanency of construction and expediency of erection.

(5) Apparent competitive structural systems in view of local constructibility parameters to include potential use of building systems fabricated off of the site.

(6) Need for fallout protection or shelter space in accordance with the Installation's Army Survival Measures Plan.

b. Functional and Technical Requirements. Examples of structural related functional and technical requirements that need to be addressed are:

(1) Allowable settlement soil bearing capacity and pile loads, as applicable.

(2) Dead, live, wind, snow and seismic design loads.

(3) Allowances for future loads or expansion.

(4) Dynamic loads, to include weapons effects, as applicable.

(5) Design methods; allowable working stress or strength (load factor).

(6) Design stresses; allowable unit stress or yield stress of materials.

(7) Deflection, to include maximum limits.

(8) Nuclear radiation (fallout) protection.

c. Design Objectives and Provisions.

Examples of structural related design objectives and provisions that need to be addressed are:

- (1) Foundation design as required by foundation or soil characteristics.
- (2) Bay sizes and module spacing for functional requirements and economy.
- (3) Seismic protection, to include symmetrical configuration of framing system, where applicable.
- (4) Type and fabrication or construction of structural system, to include the basis for selection for at least three competitive systems.
- (5) Speed of erection.
- (6) Fallout protection or shelter space potential.
- (7) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations.

The calculations for structural design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

- (1) Wind, snow, seismic and dynamic loads, as applicable.
- (2) Shears, moments and axial loads, to include stress analysis diagrams and torsional effects, where applicable.
- (3) Deflection of members and walls.
- (4) Type and sizing of foundations, structural members and connections.

(5) Uplift and stability of the structure.

(6) Expansion and crack control.

(7) Construction or erection limitations.

(8) Structural adequacy of existing structures, where applicable, to account for new functional loads or new criteria.

(9) Fallout protection factors as required, or to identify Protection Factor (PF) 40 and above shelter spaces. Include single line plans showing the location of shelter areas and minimum PF rating.

(10) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(11) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

- (1) Construction or erection limitations.
- (2) Need for fallout shelter space.

5. Mechanical.

a. General Parameters. Examples of general mechanical parameters that need to be addressed are:

(1) Temperature extremes and other impacts of climate such as wind, precipitation, sun angles and humidity.

(2) Apparent competitive mechanical systems relative to fuel alternatives, energy use budgets and environmental impacts.

(3) Indoor environmental conditions

including temperatures, humidity, pressurization, ventilation and exhaust requirements.

(4) General Heating, Ventilation and Air Conditioning (HVAC) zones and occupant capacities.

(5) General toilet and sanitation zones, and occupant capacities.

(6) Water supply pressure.

(7) Existing or planned sanitary sewer capacities.

(8) Toxic or hazardous pollutant sources.

(9) Functions and occupancies requiring mechanical lifts, elevators and cranes.

(10) Special waste and drainage systems such as acid waste.

(11) Energy sources and capacities including heating and chilled water distribution, gas distribution, and fuel storage.

(12) Building and related mechanical system commissioning.

b. Functional and Technical Requirements.
Examples of mechanical related functional and technical requirements that need to be addressed are:

(1) Design temperatures.

(2) Heating and/or cooling (air conditioning), and humidity control.

(3) Mechanical ventilation (air circulation) and special exhausts.

(4) Energy conservation, to include solar and recovery systems.

(5) Total energy and selective energy systems.

(6) Standby heating and cooling, and emergency environmental systems.

(7) Toilet fixture allocation.

(8) Hot and cold water systems, to include recovery systems.

(9) Heating and chilled water distribution, gas distribution and special liquid storage and distribution systems.

(10) Compressed air and vacuum production components.

(11) Sanitary waste and vent piping.

(12) Acid waste and chemical piping, and neutralization.

(13) Coordination with the connection to site utilities.

(14) Mechanical lifts, hoists and elevators.

(15) Control of airborne-polluting substances within the project.

(16) Control of polluting substances from energy systems.

(17) Treatment and disposal of toxic and/or polluting substances within the project.

(18) Accessibility and features for handicapped (physically impaired or disabled) persons.

c. Design Objectives and Provisions.
Examples of mechanical related design objectives and provisions that need to be addressed are:

(1) Impacts and benefits from natural warming and cooling effects afforded by the site and coordination with passive solar design.

(2) Zoning of HVAC by occupancy.

(3) Heating and/or cooling system life cycle cost design, to include the basis for selection of the system. Provide an analysis of each competitive system.

(4) System expandability and feasibility.

(5) Energy conservation.

(6) Vibration and noise isolation and control.

(7) Consolidation of toilet and sanitation facilities.

(8) Supply and waste piping systems.

(9) Connection to utilities.

(10) Mechanical lift, hoist, crane and elevator designs.

(11) Control of polluting substances.

(12) Enhancement of systems operations and maintenance.

(13) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

(14) Provisions for building and related mechanical system commissioning, and the testing adjusting and balancing of mechanical systems.

d. Calculations. The calculations for mechanical design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the

calculations shall be performed in normally accepted and recognized IP units.

(1) Heating and cooling design loads. Computerized calculations will indicate the basis of all input data.

(2) Estimated annual unit energy consumption (see architectural).

(3) Determine the design energy use and compliance with the energy use budget.

(4) Energy recovery systems.

(5) Total energy and selective energy studies.

(6) Complete system and unit capacities, indicating the dimensions of all equipment.

(7) System vibration and noise isolation and control, safety, security and fire protection.

(8) Allocation of toilet and other fixtures.

(9) Maximum flow rates in liters per minute [gallons per minute] for hot and cold water, and the total flow per day.

(10) Size of hot and cold water supply systems, to include storage tanks inside the building and the supply of water for fire protection.

(11) Size of heating and chilled water distribution, gas distribution, fuel storage, and special liquid, compressed air and vacuum systems.

(12) Size of waste water and sewage drainage systems inside the building.

(13) Sizing of mechanical lifts, hoists and passenger and service elevators. Indicate the peak hour capacities for passenger elevators.

(14) Energy system pollution abatement.

(15) Disposal systems for toxic and/or polluting substances within the project.

(16) Outside air, ventilation and exhaust air design.

(17) Supply, return and exhaust air duct sizing, and pressures.

(18) Acoustic analysis including system noise isolation and reduction.

(19) Safety, security and fire protection and suppression.

(20) Building and related mechanical system commissioning, and the testing, adjusting, and balancing of mechanical systems.

(21) Surge analysis of closed loop systems.

(22) HVAC control system parameters and constraints.

(23) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(24) Estimated cost of construction.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Total energy and selective energy planning.

(2) Operations and maintenance support.

(3) Indoor environmental requirements including temperatures, humidity, and outside and exhaust air requirements.

(4) Type, number, schedule and activity level of occupants.

(5) Equipment to be installed along with utility requirements, environmental requirements, and heat release.

(7) Requirements for mechanical lifts, hoists, cranes, and elevators.

6. Electrical.

a. General Parameters. Examples of general electrical parameters that need to be addressed are:

(1) Type of occupancies.

(2) Specialized functions and equipment.

(3) Communications support.

(4) Electrical characteristics of the power supply.

(5) Adequacy of the existing system supporting the project site.

b. Functional and Technical Requirements. Examples of electrical related functional and technical requirements that need to be addressed are:

(1) Point of interface between the existing electrical system and the system to be constructed needs to be defined.

(2) Load characteristics including connected load, demand load, diversity factors, power factor, load profiles, nonlinear loads, transformer(s) peak loading and load growth provisions.

(3) Basis for selection of primary and secondary distribution voltages.

(4) Overhead and underground exterior distribution; voltage drop, interrupting requirements, physical characteristics of the circuits including types of conductors, ampacity of service, feeder and branch conductors, pole line and duct bank, conduit, or direct buried equipment characteristics.

(5) Illumination levels, to include general and task lighting, and visual qualities of lighting requirements .

(6) Low and high system voltage.

(7) Low and high voltage switching.

(8) Loads and load factors, to include allowances for future loads.

(9) Installation and equipment standards.

(10) Emergency lighting, distribution, security, communications and standby generation systems.

(11) Power, lighting, communications and security for site elements.

(12) Communications, to include call systems.

(13) Electronic clock systems.

(14) Electronic security, surveillance and Intrusion Detection Systems (IDS).

(15) Audio visual systems, to include central television (TV) systems.

(16) Energy conservation and energy monitoring.

(17) Power generation.

(18) Electromagnetic protection (EMP).

(19) Explosion-proof connections in hazardous environments.

c. Design Objectives and Provisions. Examples of electrical related design objectives and provisions that need to be addressed are:

(1) Electrical feeder and distribution systems.

(2) Spare capacities.

(3) General illumination and task lighting coordinated with interior layouts, safety and security requirements.

(4) Relamping and adjustments.

(5) Nonlinear loads and harmonics.

(6) Communications systems.

(7) Emergency power generation and distribution.

(8) Energy conservation.

(9) Enhancement of systems operations and maintenance, to include systems flexibility.

(10) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for electrical design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Maintained lux [Foot candle (FC)] levels in all areas. Where areas are similar in size and usage, only a typical calculation is required.

(2) Individual circuit and system loads

tabulated in amperes for each panel board or switchboard.

(3) Transformers, generators, switchboards and feeders indicating all demand, diversity, and ambient-temperature or conductor-grouping factors considered in the selection of equipment or conductor sizes.

(4) Cost comparison of illuminating, power and communication systems.

(5) Nonlinear loads and harmonic contributions, kilowatt rating of transformers, etc.

(6) Ground fault and its circuitry protection.

(7) Selective system protection.

(8) Voltage-drop on all service and feeder circuits, and on worst-case branch circuits supplied by each panel board and switchboard.

(9) Weight, dimensions and electrical characteristics of each major item of equipment supported by manufacturer's names, and catalog and model numbers.

(10) Cost comparison of competitive designs and materials, in terms of both construction costs, acquisition costs, and life-cycle costs in accordance with TM 5-802-1.

(11) Estimated cost of construction.

(12) Short circuit calculations.

(13) Electromagnetic Protection.

e. Coordination with Installation or Outside Agencies, i.e., electrical utility company, and the Installation's electrical distribution organization. Coordination should include, but not be limited to:

(1) Telephone system requirements and availability.

(2) Central TV.

(3) Power requirements of the installation's service and cleaning equipment of the installation.

(4) Provost Marshal or police response to IDS alarms.

(5) AR 190-13 for Army physical security, IDS design approvals, when required.

(6) Incorporation of maintenance and commissioning requirements of the Installation.

(7) Intrusion Detection System (IDS) Center of Expertise, Huntsville Engineer Technical Center, for design assistance.

(8) Utility Monitoring and Control System (UMCS) Center of Expertise, Huntsville Engineer Technical Center, for UMCS/EMCS design assistance.

7. Fire Protection and Life Safety.

a. General Parameters. Examples of general fire protection parameters that need to be addressed are:

(1) Types of occupancies.

(2) Hazard classification of specific areas and list of hazards.

(3) Specific criteria; standards and codes.

(4) Type of construction.

(5) Type of fire protection.

(6) Water supply.

b. Functional and Technical Requirements.

Examples of fire protection related functional and technical requirements that need to be addressed are:

(1) Fire resistance of building components, to include floor and ceiling assemblies, exterior and interior walls, permanent partitions, shafts, and location of fire separation walls and partitions.

(2) Allowable floor area and building height in accordance with the Uniform Building Code (UBC) based on occupancy classification, construction, separations and fire suppression or protection.

(3) Exit requirements in accordance with NFPA 101, Life Safety Code (LSC). The design and analysis must address exit types, required exit widths, maximum travel distance for exiting, dead-end distances and common exit paths of travel limitations, arrangement of exits, remoteness of exits, discharge from exits, illumination of exits and exit marking.

(4) Flame spread and smoke development rating of interior finishes and insulations.

(5) Building access for local fire department fire fighters.

(6) Building separation and exposure protection.

(7) Smoke control methods.

(8) Automatic extinguishing systems.

(9) Fire alarm evacuation systems.

(10) Fire detection systems.

(11) Fire hydrants and standpipes.

(12) Water supply, to include new or

additional water storage, pumping, and/or water distribution mains.

(13) Special hazards and methods for protection.

c. Design Objectives and Provisions.

Examples of fire protection related design objectives and provisions that need to be addressed are testing and field investigation reporting requirements:

(1) Water flow tests at the point of connection for sprinklered buildings.

(2) Existing water supply.

(3) Existing fire hydrants.

(4) Existing fire alarm reporting system information for connection of new fire alarm systems.

(5) Economy of Construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for fire protection design elements, such as those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

(1) Complete exit requirement calculations based on the LSC.

(2) Allowable floor area and building height calculations based on UBC.

(3) Water supply calculations indicating the adequacy of the design to meet sprinkler and hose stream flow demands. Calculations must be based on residual and static pressures and flow data obtained from water flow tests.

(4) Sprinkler calculations to determine water flow and pressure demands.

(5) Fire alarm system calculations for elements such as, wire sizing, battery, and alarm annunciator sound level.

(6) Complete hydraulic design calculations for detailed sprinkler and Aqueous Film Forming Foam (AFFF) system designs.

(7) Layout and sizing of special fire extinguishing systems, such as carbon-dioxide, halon, and AFFF (low pressure foam system).

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

(1) Fire fighting support, to include tie-ins with local fire department alarm and communication systems.

(2) Adequacy of water supply, to include flow tests.

(3) Inspection and testing of systems performance.

(4) Obtain the specific fire alarm type(s), fire protection and central reporting requirements of the Installation's Fire Marshall/Chief.

8. Physical Security.

a. General Parameters. Examples of general physical security parameters that need to be addressed are:

(1) Mission of the project.

(2) Size of the site.

(3) Installation threat statement.

(4) Anticipated aggressor tactics.

(5) Personnel and materials being protected.

(6) Activities performed.

(7) Security forces available.

b. Functional and Technical Requirements. Examples of physical security related functional and technical requirements that need to be addressed are:

(1) Defensible site layout.

(2) Securable building layout.

(3) Resistance to aggressor penetration.

(4) Vandal-proofing.

(5) Intrusion denial.

c. Design Objectives and Provisions. Examples of physical security related design objectives and provisions that need to be addressed are:

(1) Maximum security.

(2) No detracting from mission.

(3) Cost effective security features.

(4) Provisions for expansion.

(5) Efficient security zoning.

(6) Maximum use of standard designs.

(7) Economy of construction and procurement, and life-cycle cost effectiveness in accordance with TM 5-802-1.

d. Calculations. The calculations for physical security design elements, such as

those listed below, will utilize metric units. If the project is permitted to use IP units, the calculations shall be performed in normally accepted and recognized IP units.

- (1) Time for aggressor to penetrate.
- (2) Time for security force to respond.
- (3) Power requirements for security systems.
- (4) Protective lighting intensities.
- (5) Costs.

e. Coordination with Installation or Outside Agencies. Coordination should include, but not be limited to:

- (1) Conformance to the installation security plan.
- (2) Appropriate local police agencies regarding patrol and alarm responses.

(3) Signal office regarding security communications.

(4) Security office regarding any AR 380-5 for classified material protection requirements.

(5) Protective Design Center of Expertise (Omaha District Engineer Office).

(6) Intrusion Detection System Center of Expertise, Huntsville Engineering and Support Center, for design assistance.

(7) Installation military police regarding any Army physical security of arms, ammunition and explosives, protection requirements.

(8) Intrusion detecting system approval in accordance with Army physical security criteria, when required.

(9) Installation medical office regarding any AR 190-50 requirements.

(10) Facility user regarding any automation security requirements.

- PART 3 -

OPERATION AND MAINTENANCE (O&M) PROVISIONS

1. Using Service Responsibilities For O&M.

The following are using service responsibilities for O&M that should be considered by the design agency during the design development process:

a. Control Responsibilities.

(1) Parking allowances and assignment.

(2) Pavement and floor loadings.

(3) Spare parts, equipment, consumables, and miscellaneous storage.

(4) Energy use.

(5) Site access restrictions.

b. Service Responsibilities.

(1) Access-egress maintenance.

(2) Landscape maintenance.

(3) Snow and ice removal.

(4) Housekeeping, trash collection and disposal.

(5) Signage.

(6) Mail handling, shipping and receiving.

(7) Food service and supply.

(8) Health (dispensary) and sanitation.

(9) Reproduction (copy) service.

(10) Vending (state blind agencies and others).

(11) HVAC systems.

(12) Electrical and communications services.

(13) Security and fire protection.

(14) Shop support.

(15) Plumbing systems.

(16) Lifts, hoists, cranes, and elevators.

(17) Compressed air and vacuum systems.

(18) Fuel storage and dispensing systems.

(19) Industrial gas systems.

(20) Treatment facility operation and maintenance.

(21) Residuals disposal and manifesting.

(22) Permit compliance monitoring.

(23) Extraction/injection remediation system maintenance.

(24) Worker safety and occupational health.

2. Provisions For O&M Enhancement and Cost Reduction. The following are provisions for O&M enhancement and cost reduction that should be considered by the design agency during the design development process:

a. Control Related.

(1) Preventive overloading factors.

(2) Food service efficiency maximizers, preparation, serving, seating and dish washing.

(3) HVAC efficiency maximizers; sub- and main plant.

(4) Lighting efficiency maximizers, intensities and switching.

(5) Communications efficiency maximizers.

(6) Elevator efficiency maximizers.

(7) System expandability and flexibility.

b. Service Related.

(1) Below-grade flood protection.

(2) Above grade solar, water, and wind protection and resistance.

(3) Finish materials, textures and colors.

(4) Window washing provisions.

(5) Provisions for cleaning equipment.

(6) Vibration and expansion contraction controls.

(7) Energy conservation and pollution control measures.

(8) Access to mechanical systems; HVAC, elevators, plumbing, process and special equipment.

(9) Provisions for building and system recommissioning and testing, adjusting and balancing of mechanical, electrical and communications systems.

(10) Relamping and lighting relocation.

(11) Electrical distribution allowance for future loads.

(12) Emergency power system testing, and monitoring power quality.

(13) Vandalism and intrusion resistance.

(14) Confined spaces reduction/elimination or identification.

(15) Toxic or hazardous pollutant sources and exposure potentials.

APPENDIX C

DRAWINGS

1. General. This appendix prescribes the requirements, procedures and drafting standards for the preparation and approval of drawings for military construction and/or HTRW projects. It includes drawings, other than shop drawings, prepared at all stages of design and construction.

2. Standard Drawings. Standard drawings are developed under the guidance and criteria issued by HQUSACE (CEMP-E). A listing of current standard drawings is available from the TECHINFO system accessed through the USACE Home Page on the Internet, <http://www.hnd.usace.army.mil>, or by direct telephone dialing the system data line at (205) 895-1826. The purpose of standard drawings is to aid in project planning and design, and to reduce the cost and time for the preparation of project drawings.

a. Types of Drawings. Types of standard drawings are described as follows:

(1) Standard Design Drawings. Standard design drawings can range in completeness from definitive or sketch level, to completed construction documents with the drawings of sufficient detail as to materials and methods of construction to serve as project construction drawings after the necessary field modifications covering site adaptations and deletion of inapplicable materials.

(a) Standard designs generally provide for site adaptation in widely separated geographical areas with design data for different climatic and seismic conditions, and building materials. Alternate wall sections, details and building elevations are included as required to illustrate

these variations.

(b) These drawings are sometimes accompanied by a standard technical guide specification.

(2) Definitive Design Drawings. Definitive design drawings delineate functional layouts, space allowances, special features or requirements, and the configuration of elements both horizontally and vertically. Definitive design drawings usually recommend basic building systems; materials and construction details; architectural treatments; and structural, mechanical, electrical and fire protection systems with criteria and guidance necessary for making selection. These drawings typically include floor plans, elevations and cross sections with controlling and critical dimensions, gross and net area tabulations. Definitive design drawings also address the most likely and alternative site support facilities and utility requirements for mechanical and electrical systems. These drawings are sometimes accompanied by a design analysis.

(3) Department of the Army (DA) Facilities Standardization Program Standard Design Packages. The drawings in these packages are normally developed to a level of design that is similar to definitive design drawings. The basic DA Standard Design Package includes both standard design drawings and design analysis. Additional requirements and information on the DA Facilities Standardization Program are contained in ER 1110-3-113 and AR 415-15.

(4) Sketch Design Drawings. Sketch designs are usually single-line drawings delineating functional layouts, space allowances

and the basic features of a facility type. These drawings typically include plans, and elevations and cross sections with controlling dimensions and area tabulations.

(5) Design Guide Drawings. Design guides are published and issued in printed form with both narrative and graphic data to describe the functional layout, space allowance and special features of a facility type. Design guides typically include drawings delineating individual space requirements, and drawings showing the organization of spaces into alternative facility layouts and designs. These designs are usually illustrated further by plans, and elevations and cross sections with controlling dimensions and area tabulations. Perspective sketches may be included to illustrate recommended interior designs and exterior design treatments. Drawings are reduced to manual size for publication.

(6) Project Design Drawings from the CADD Library. These drawings are completed facility specific project documents available for site adapt use to reduce cost and time for the preparation of project drawings.

b. Modification of Standard Drawings. The design agency responsible for the development of a project design is authorized to modify standard drawings, except those drawings contained in the DA Facilities Standardization Program standard design packages, to meet local siting, foundation, topographic, climatic and seismic conditions, energy and utility availability, and life cycle cost. Criteria and waiver request procedures for DA Facilities Standardization Program designs are governed under ER 1110-3-113, and DAIM-FDR memorandum, 7 Oct 95, SUBJECT: Request for Waivers from the Use of DA Standard Design and Space Planning Criteria.

(1) Modifications. Modifications to standard drawings are authorized to avoid

unnecessary construction features or costs, to correct errors, and to adapt the drawings to local materials and methods of construction, metric measurements (when originally prepared in IP unit measurement), or CADD techniques.

(2) Directed Modifications. Other modifications may be directed by HQUSACE (CEMP-E) in AEI or design directives. Modifications and changes may be promulgated through Engineer Technical Letters (ETL) or revisions to guide specifications.

(3) Deviations. Modifications that cause deviations from functional and operational requirements, space criteria or cause significant increases in cost shall be avoided. Deviations to the functional and operational requirements contained in DA Facilities Standardization Program standard design drawings are unauthorized.

c. Deficiency Reports and Recommendations. HQUSACE (CEMP-EA) will be promptly informed of any errors or omissions in DA Standard Designs, including drawings. Under the provisions in ER 1110-345-100, ENG Form 3078 may be used for this purpose or the deficiency may be reported directly to HQUSACE (CEMP-EA), Washington, DC 20314-1000.

3. Project Drawings.

a. Concept Design Drawings. Concept designs are used to define the functional, technical, and architectural and engineering aspects of a project, and to help verify project costs in order to provide a firm basis upon which to initiate the final project design. Completion of concept design drawings, together with a design analysis, outline specifications and cost estimate, normally represents about one-third of the total design effort. Concept designs will be prepared in accordance with AR 415-15, utilizing the

project requirements documents and applicable standard drawings.

(1) When standard design drawings are used, the drawings for the new project will include appropriate sheets from those drawings modified to depict site adaptations and other essential requirements. Duplication will be avoided except as required for clarity.

(2) Concept design drawings will generally include the following information:

(a) Project site plan showing existing and proposed buildings, roads, parking, landscape planting masses, contours, and the utilities in the immediate vicinity of the project.

(b) Building floor plans, cross sections and elevations showing the functional layout, space configuration and form, and building system characteristics, to include the required properties and/or performance of the construction materials and methods.

(c) Design details of exterior and interior elements; schedule of windows, doors, and finishes and colors; details related to architectural, structural, mechanical, electrical and fire protection systems; and energy usage and other special requirements.

(d) Foundation plans and details showing geotechnical investigation results, boring data, subsurface soil classification, allowable soil bearing capacity, ground water elevations, etc.

b. Final Design Drawings. Final design drawings will be prepared from the approved concept designs. When standard design drawings are used, additional sheets will be incorporated as appropriate. Final design drawings together with a complete design analysis, construction specifications, and a cost estimate covering all technical, architectural and engineering details will form the basis for

construction contracting. The drawings will be sufficient in detail to provide for fair and competitive bids from contractors, and to provide for the construction of the project without additional drawings, except for shop drawings or as may be required to deal with unforeseen conditions encountered during construction.

c. Shop Drawings. These are drawings submitted by a contractor, manufacturer, vendor or others, which show in detail the proposed fabrication and assembly of specific building components or which show the installation details (i.e., form, fit and attachment) of materials or equipment. Preparation, approval and transmittal of shop drawings are outside the scope of this regulation.

d. As-built Drawings. As-built drawings will be prepared as part of the completion records transferred to the using service upon completion of the project. The contract drawings will be revised and corrected to indicate the actual construction of the project, including all change orders. Site plans, building plans, cross sections and elevations, schedules and all other portions of the drawings to include the location of mechanical services, utility lines and outlets, will be revised to provide a clear understanding of the project, as built. As-built drawings, together with as-built construction specifications, final shop drawings and the design analysis will be furnished to the using service in accordance with ER 415-345-38.

4. Drawing Preparation. Drawings will be prepared so as to clearly and adequately delineate the work to be accomplished.

a. Quality. Because of the number of copies of drawings normally required for a project, most drawings are reduced to half-size for reproduction. Original drawings and details; therefore, must be of adequate size, and be

clear and sharp, so that the use of half-size reproducibles will result in legible and easy to read copies.

b. Drafting Standards and Practices.

Format and organization, control data blocks, drawing conventions, schedules and standard details will conform to the requirements and guidance contained in paragraph 5 of this appendix.

c. Codification. Drawing sheets will be assigned a drawing code in accordance with the guidance contained in paragraph 10 of this appendix.

d. Metrication. The criteria and requirements for the application of metric measurements in drawings were addressed in paragraph 4 of this regulation. The following ANSI and ASTM standards will be used in the preparation of drawings:

(1) American National Standards Institute. 28 October 1992. "American National Standard for Metric Practice," ANSI/IEEE 268-1992, IEEE Standards Coordinating Committee 14 on Quantities, Units, and Letter Symbols, New York.

(2) American Society for Testing and Materials. 1991. "Standard Practice for the Use of Metric (SI) Units in Building Design and Construction," ASTM E 621-84 (Reapproved 1991), Committee E-6 on Performance of Building Construction, Philadelphia, PA.

(3) American Society for Testing and Materials. 1992. "Standard Practice for the Use of the International System of Units (SI) (the Modernized Metric System)," ASTM E 380-92, Committee E-43 on Metric Practice, Philadelphia, PA.

e. Computer-Aided Design and Drafting (CADD). Commercially available CADD systems

have demonstrated significant potential for improving the efficiency and quality of drawing production. Standards for USACE CADD application are contained in Tri-Service CADD/GIS Technology Centers Architectural, Engineering and Construction (A/E/C) CADD Standards available at Internet site <http://mr2.wes.army.mil>. Those criteria that meet the quality requirement in the paragraph above are acceptable for use in preparing project and other drawings. Manually prepared drawings will also follow the general guidance in this manual as it applies to general drafting standards.

5. Drafting Standards and Practices.

a. Format and Organization.

(1) Concept and final design drawings, and drawings for standard and definitive designs, will be prepared on standard A1 metric size sheets, 594 mm x 841 mm (23.39 inches x 33.11 inches); an American National Standards Institute (ANSI) "D" equivalent sheet.

(2) When preparing large maps, i.e., installation master plans and drawings for Civil Works projects, the standard A0 metric sheets; 841 mm x 1189 mm (33.1 inches x 46 inches) should be used; an ANSI "E" equivalent sheet.

(3) When preparing half-size drawings for inclusion to booklets such as "Design Analysis," the standard A3 metric sheet; 297 mm x 420 mm (11.7 inches x 16.5 inches) should be used; an ANSI "B" equivalent sheet, that conveniently folds in to the standard A4 metric size; 210 mm x 297 mm (8.3 inches x 11.7 inches), an ANSI "A" equivalent sheet.

(4) The sheet layout, including the standard title and information blocks, for drawings are provided at Figure C-1 and Figure C-2 which depict expanded views of the title, revision and other information blocks on the

standard sheet.

b. Cover Sheet.

(1) Project drawings will have a cover sheet or sheets with the project name, project location, design agency logo and identification, project number and fiscal year. Applicable file numbers will be included as appropriate. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

(2) Cover sheets for in-house work shall comply with the requirements of ER 1110-1-8152, paragraph 6 concerning signatures, and will include the following statement:

"This project was designed by the (name of district) District of the U.S. Army Corps of Engineers. The initials or signatures and registration designations of individuals appear on these projects documents within the scope of their employment as required by ER 1110-1-8152."

c. Index Sheets. Project drawings, and drawings for standard and definitive designs, will have an index sheet or sheets. The index sheet or sheets will identify by reference number, date and title, each of the other sheets in the set of drawings, and indicate the total number of sheets in each design discipline group. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

d. Legend Sheets. A legend sheet or sheets should follow the index sheet or sheets, or may be combined with the index sheet or sheets. The legend sheet or sheets will include definitions of abbreviations used; legends for materials, mechanical and electrical symbols; a graphic illustration of details and cross section reference indicators; and other information as required for that particular set of drawings. The

overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2

e. Drawing Sheets. Drawing sheets will follow the cover, index and legend sheets in order of the following design discipline groups: civil to include the site design; architectural to include interior design; structural; mechanical; electrical; and others. The architectural drawings should normally show plans, elevations, cross sections and details in that order. The overall sheet layout of title and other information blocks shall follow the theme in Figure C-1 and Figure C-2.

f. Supplemental Drawing Sheets. When it is required that any drawing sheet for a specific project be redrawn and/or new drawing sheets added, such as in the preparation of as-built drawings or contract modifications, the redrawn or new drawing sheets will be consecutively numbered to follow the last drawing sheet of the design discipline group. The basic sheet that is replaced or supplemented by a supplemental drawing sheet will be retained in its original position with a note in the revision block indicating the sheet number where the changed conditions are shown.

6. Control Data Blocks.

a. Title Blocks. Except for the cover sheet, title blocks will be placed on each individual drawing sheet in the space inside the right hand margin of the drawing sheet, as indicated in Figure C-1, to identify the name of the project, the project number and fiscal year, and the installation where the project is located. Title block data will also include the title of the drawing on the sheet, the sheet reference number, the drawing code assigned in accordance with paragraph 10 of this appendix, applicable local file numbers, and the approval date of the drawing sheet. Local design agency standards may be used for recording in the title

blocks of individual drawing sheets, the names or initials of the person or persons responsible for the design, drawing and checking of each drawing sheet, and for overall review and approval in accordance with ER 1110-1-8152 . However, the local design agency standard shall comply with the sheet size standards in the appendix, and the standard configuration at Figures C-1 and C-2.

b. Authentication Blocks. Authentication blocks will be placed on the index sheet or sheets to the left of the title block. Authentication blocks will provide spaces for the signatures of those individuals responsible for the preparation, review and approval of the drawings. Approval is required for both technical and functional adequacy. Space will also be provided to indicate the date of approval next to the signature. Use of authentication blocks on other drawing sheets will be at the discretion of the design agency responsible for the design.

c. Revision Blocks. Except for the cover sheet, revision blocks will be placed on each drawing sheet above the title block to describe any revision made to the drawings, to indicate the number and date of the revision, and the initials of the official approving the revision; see Figure C-1.

7. Drawing Conventions. Methods used for drawing, lettering, dimensioning and cross-referencing must be economical and assure legibility when drawing sheets are reduced to half-size sheets. Lettering styles and sizes should be standardized within a set of drawings regardless of the design discipline involved.

a. Symbols. Symbols used in the preparation of civil, architectural, structural, mechanical, electrical and other drawings will reflect usage, for example, established by the American National Standards Institute (ANSI) standards or generally accepted professional

standards.

b. Abbreviations. Abbreviations will reflect common usage.

c. Scales. Graphic scales will be provided on drawings to allow for measured scaling. Project drawings, standard and definitive designs will generally be drawn to the scales indicated in Table C-1.

Table C-1
Drawing Scales

Type	SI Metric	Inch-Pound (IP) Customary Equivalent
Site Plan	1:250 /1	(1" = 25')
	1:200	(1/16" = 1'-0")
Floor Plan	1:50 /2	(1/4" = 1'-0")
	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Roof Plan	1:200	(1/16" = 1'-0")
Exterior	1:10	(1" or 1-1/2" = 1'-0")
Elevation	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Interior	1:50	(1/4" = 1'-0")
Elevation	1:100	(1/8" = 1'-0")
Boring	1:10	(1" or 1-1/2" = 1'-0")
Logs	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Cross-	1:50	(1/4" = 1'-0")
Section	1:100	(1/8" = 1'-0")
	1:200	(1/16" = 1'-0")
Wall	1:20	(1/2" or 3/4" = 1'-0")
Section		
Stair Detail	1:10	(1" or 1-1/2" = 1'-0")

Table C-1
Drawing Scales, Continued

Type	SI Metric	Inch-Pound (IP) Customary Equivalent
Details	1:5	(3" = 1'-0")
	1:10	(1" or 1-1/2" = 1'-0")

/1 May be necessary for landscape plans

/2 May be used for partial floor plans

d. Keys. All cross-referencing conventions, symbols and abbreviations will be keyed, and shown on the legend and other drawing sheets as appropriate.

e. Revisions. Conventions for describing revisions will include marking of the area of the drawing sheet revised so that the area can be easily located.

7. Schedules.

a. Window Schedules. A tabular schedule of windows will also be included on the drawings. Each type of window will be assigned a number preceded by the letter "W." An elevation drawing of each type of window will be provided along with pertinent details. Every window will be clearly indicated by type on the elevation drawings.

b. Door Schedules. A tabular schedule of doors will be included on the drawings. Every door will be assigned a separate number and this number will be clearly indicated on the plans. Door numbers should be as nearly consecutive as possible, by floor, beginning with the principal building entrance area and progressing counter-clockwise through the plan. An elevation drawing of each type of door, identified by an upper case letter will indicate the material of which the door is made and other pertinent details. Details of each type of

door frame will be shown and each type will be identified.

c. Finish and Color Schedules. A tabular schedule of interior finishes and colors will be included on the drawings. Finish and color schedules should identify by room number the finish materials and colors to be used for the floor to include the base, the walls to include any wainscoting and trim, and the ceiling. The meaning of the abbreviations used in naming the materials and finishes will appear on the legend sheet or on the same sheet as the schedules.

8. Standard Details. The classification and type of standard details on drawings will conform as "CLASS 40" listed in Table C-2. When sequence numbers for standard details, i.e., DET 40-06-04 is Lighting Fixtures, are established; the sequence numbers are obtained from the U.S. Army Engineering and Support Center, Huntsville (CEHNC-ED-ES), telephone (205) 895-1402.

Table C-2
Class 40 - Standard Details

Type No.	Type of Detail
01	Architectural Details
02	Structural Details
03	Heating Details
04	Equipment Layouts & Details
05	Legends, Notes, Schedules, and Symbols
06	Electrical Details
07	Water System Details
08	Sanitary Sewer Details
09	Gas System Details
10	Field Survey Details
11	Athletic Equipment Details
12	Railroad Details
13	Plumbing details
14	Air Conditioning Details
15	Fire Protection Details
16	Fence Details
17	Pavement, Curb and Sidewalk Repair Details

Table C-2
Class 40 - Standard Detail, Continued

Type No.	Type of Detail
18	Storage Racks, Grounds & Equipment Details
19	Tent Frame Details
20	Storm Water Details
21	Standard Component Layouts and Details
22	Kitchen Equipment Layouts and Details
23	Overhead Carrier System Details
24	Aircraft Arresting Barrier Details

9. Area Computations and Room Numbering.

a. Area Computations. Gross area of buildings and net area breakdowns for each floor will be provided on plans and computed in accordance with the method specified in AR 415-17, AEI Design Criteria.

b. Room Numbering. Every room will be assigned a separate number and this number will be clearly indicated on the plans. Room numbers will generally be assigned as shown in Table C-3. Room numbers should be as nearly consecutive as possible, beginning with the principal entry area and progressing counter-clockwise through the plan. Spaces added by revision should be given the number of the primary or nearest room followed by the letter "A," or if more than one additional space "B."

Table C-3
Room Numbering

Floor	Numbering Sequence
Basement	01 through 99
First	100 through 199
Second	200 through 299

10. Drawing Codification. Drawings will be assigned a drawing code consisting of a letter prefix and three numerical parts as follows:

a. Prefixes. Letter prefixes will be used to differentiate between the various types of drawings, and between drawings prepared for Army, Air Force, and other projects as shown Table C-4.

Table C-4
Drawing Prefixes

Drawing other	Type	Army Prefix	Air Force Prefix	
Project Drawings	Concept	C	AC	XC
	Final	F	AF	XF
	As-Built	AS-BLT	AS-BLT	AS-
BLT				
Standard Drawings	Standard	STD	AW	XW
	Definitive Design	DEF	AD	XD
	Sketch Design	SK	ASK	XSK
	Design Guide	DG	-	-

b. Class Number. The first numerical part of the drawing code is a class number based on the first three digits of the facility category codes given in AR 415-28, and for Air Force projects obtain the information from the project Air Force command.

c. Type Number. The second numerical part of the drawing code is a type number based on the last two digits of the facility category codes given in AR 415-28 for Army projects, and the last three digits given Air Force Command for an Air Force project.

d. Sequence Number. The third numerical part of the drawing code is a chronological

sequence number to indicate succeeding numbers of drawings for a particular class and type of building or structure prepared within a particular design agency.

(1) Sequence numbers for project drawings will be assigned by the design agency responsible for the project and follow the criteria in this appendix. The first sequence number will be 01 after implementation of the coding system herein.

(2) Sequence numbers for standard drawings will be assigned by HQUSACE (CEMP-EA).

e. Examples. The following subparagraphs show how prefixes and numbers are combined to form a complete drawing code:

(1) To establish the drawing code for a training facility; the class number is 171, training buildings. If the facility is for the Army and for general instruction, the type number is 20; if the facility is for the Air Force and for pilot training, the type number is 213. Assuming this coding is the first design for this type of facility by the design agency since implementation of the coding system herein, the sequence number is 01.

(2) For the above example, the drawing code at the concept design stage becomes C-171-20-01 for an Army project and AC 171-213-01 for an Air Force project. A sequence number once assigned, is henceforth fixed for that particular set of drawings.

(3) During the development of drawings from the concept to final design stage, the numbers are retained but the prefix is changed from C to F. The drawing code at the final design stage becomes F-171-20-01 for an Army project and AF 171-213-01 for an Air Force project.

(4) In the case of an Army project standard design, the drawing code is STD 171-20-01, or AW 171-213-01 for an Air Force project. These drawing codes will be assigned by HQUSACE (CEMP-EA). The drawing code assigned by the design agency in site adapting this standard to an Army project would be F-171-20-01, assuming this was the first set of drawings for this type of facility prepared by the design agency.

(5) When modifying the final drawings to reflect as-built conditions, the numbers are retained but the prefix will be changed from F to AS-BLT. The drawing code becomes AS-BLT 171-20-01 for an Army project and AS-BLT 171-113-01 for an Air Force project (confer with the project's Air Force Command).

(6) If a final project drawing is designated as a standard drawing, the basic class and type numbers are retained, but the sequence number is changed to that assigned by HQUSACE (CEMP-EA). The prefix is also changed from F to FD to indicate designation as a field design.

11. Use of Additional SE Coding or Numbering Systems. No changes will be made in the coding system prescribed herein without prior approval of HQUSACE (CEMP-EA). If a design agency requires a class or type number not clearly covered by the facility category codes in AR 415-28, an appropriate number will be furnished upon request to HQUSACE (CEMP-EA). All requests concerning Air Force definitive numbers and facility nomenclature should be made to the Air Force Civil Engineer Support Agency, Tyndall AFB, FL 32403-53191, and the project's Air Force Command. When a design agency requires an additional coding or numbering system to comply with an existing system, these additional codes or numbers may be included on the drawings.

12. Review and Approval of Project Drawings.

a. Using Service. Submittal of drawings to the using service for review and approval of the functional aspects of the design will be compatible with the provisions of AR 415-15 .

b. Corps of Engineers Design Agency. Review and approval of drawings by the design agency will be in accordance with the design verification provisions set forth in ER 1110-345-100.

c. Headquarters, U.S. Army Corps of Engineers (HQUSACE). Project drawings shall not be submitted to HQUSACE (CEMP-E), except as provided by specific regulations, design directive or other HQUSACE instructions. Review or approval by HQUSACE (CEMP-E), that is directed by regulation or HQUSACE (CEMP-E) instruction, will in no way relieve the design agency of its approval responsibility.

13. Drawing Authentication. Approved drawings will be so designated by authentication on an index sheet or sheets that identifies by reference number, date and title, each of the other sheets in the set. This sheet or sheets will bear the signature of the appropriate officials responsible for the preparation, review and approval of the drawings. Drawings will be certified as official

and final, see ER 1110-1-8152.

14. Modification of Project Drawings After Approval. The design agency responsible for the project design is authorized to make modifications to the project drawings that have been approved in accordance with paragraph 12 of this appendix to correct errors, omissions and ambiguities, or to meet changes in local conditions occurring during construction.

a. Modifications after Approval. Modifications may be undertaken provided that the modifications are necessary or desirable to allow construction to proceed in an efficient and economical manner, and do not alter the quality of construction, general functions, appearance or scope of the project.

b. Identifying Modifications. Modification of project drawings will be clearly indicated and identified by date and the office authorizing the change.

15. A-E Prepared Drawings. A-E contractor drawings shall comply with Figure C-1 and Figure C-2, and ER 1110-1-8152, paragraph 7. A-E contractor prepared drawings shall not be signed as accepted or approved by Corps of Engineers' personnel.

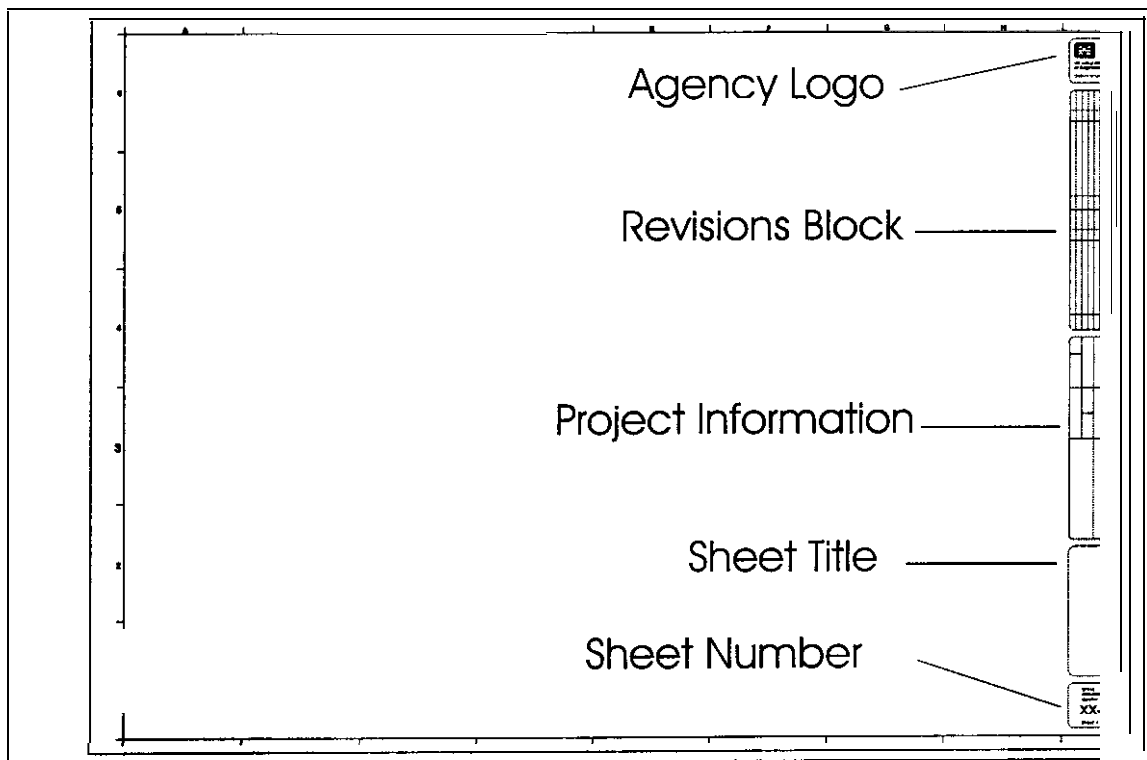


Figure C-1 Metric Sheet with
Vertical Title Block

1\ Cover Sheets for in-house work must include the statement as indicated in Appendix C, paragraph 15 of this ER.

Sheet
Reference
Number
XX--0
Sheet 1 of X

INFORMATION
4 LINES
PROVIDED

SHEET TITLE
3 LINES
PROVIDED

ENGINE LONGS AP ENGINEERS CITY, STATE	Drawn by:	Design file no.
	Reviewed by:	Drawing code:
	Submitted by:	The name:
		Plot date:

Item	Unit	Quantity	Unit Price	Total Price	Remarks
1. Material					
2. Labor					
3. Subcontract					
4. Other					
5. Total					
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US Army Corps
of Engineers
District or Division

This image shows a blank, lined page from a notebook. The page features horizontal ruling lines and a vertical margin line on the left side. The page is numbered 1 in the bottom right corner. The paper has a slightly aged, off-white appearance.

C-1 2